

Applicant : Darin Evans et al.
Appln. No. : 10/562,099
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In the Title:

Please replace the title of the present application with the following amended title:

"BUMPER ENERGY ABSORBING SYSTEM INCORPORATING THERMOFORMED
ENERGY ABSORBER"

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In the Specification:

Please amend the paragraph beginning on page 1, line 4, as follows:

The present invention relates to ~~vehicle bumper systems~~ energy absorbing systems for absorbing energy in and around vehicles, and in particular relates to ~~bumper-energy absorbing~~ systems for passenger vehicles incorporating a thermoformed energy absorber.

Please amend the paragraph beginning on page 1, line 6, as follows:

Modern ~~bumper-energy absorbing~~ systems are designed to absorb a maximum of impact energy over a given stroke. At the same time, they are designed to minimize load spikes, and to distribute energy in a manner promoting uniform and predictable collapse upon undergoing a vehicle crash. Every centimeter of space is important to energy absorption, even spaces of 10 mm or less. Further, the individual components of an energy absorbing system must combine well with other energy absorbing components, e.g. metal tubular beams and non-tubular channels, injection-molded "honeycomb" energy absorbers, foam "block" energy absorbers, hydraulic shock absorbers, crush towers and mounts, and various combinations thereof. At the same time, light weight must be maintained. Also, it is desirable to maintain an ability to customize energy absorption at selected impact zones (e.g. at a corner of the vehicle or at a center impact, such as with a post impact). Concurrently, all components of a bumper system must be flexible, and able to conform to an aerodynamic sweeping curvature of a vehicle front.

Please replace the current "SUMMARY OF THE INVENTION" with the following "SUMMARY OF INVENTION":

In one aspect of the present invention, an energy absorbing system for absorbing impact energy in a vehicle collision includes an elongated structural beam with a relatively flat face, and a thermoformed energy absorber supported on the face, the energy absorber being formed

from a single sheet of material by a thermoforming process to have a base flange and a plurality of thermoformed longitudinally-elongated crush boxes that extend generally perpendicularly from the base flange in a fore/aft direction parallel a direction of expected impact. The crush boxes each have opposing side walls and orthogonally-related end walls and a side-wall-supported front wall with the crush boxes each being spaced apart from each other along the base flange. The crush boxes each define a separate rearwardly-facing opening, and the side walls, end walls, and front walls are continuous. The energy absorber defines a forward-facing surface and a rearward-facing surface, each being open and unobstructed in a linear direction parallel the fore/aft direction and not having undercut surfaces, whereby the energy absorber can be thermoformed from the sheet of material by passing a portion of mold tooling in a forming direction parallel the fore/aft direction through the base flange linearly into the rearwardly-facing openings defined by the crush boxes. The opposing side walls are stretched during the thermoforming process and have a thickness dimension less than a thickness of the front walls and of the base flange due to the thermoforming process.

In another aspect of the present invention, a system includes a beam having a face and at least one elongated recess formed in the face, and a thermoformed energy absorber formed from a sheet of polymeric material and having a base flange and crush boxes formed in the energy absorber in a direction perpendicular to the base flange and further having at least one thermoformed ridge extending from the base flange into engagement with the recess to retain the energy absorber on the face during a vehicle crash.

In another aspect of the present invention, a system includes a metal beam having a face. A first polymeric energy absorber has energy-absorbing blocks selected from one or both of hollow crush boxes and foam blocks. A thermoformed second polymeric energy absorber covers a substantial portion of a front of the first polymeric energy absorber, the second polymeric energy absorber including a base flange engaging the first polymeric energy absorber and including at least one crush box formed therein.

In yet another aspect of the present invention, an energy absorbing system includes a beam having a face, an energy absorber abutting the face including a thermoformed component, and a cover covering the beam and the energy absorber. The thermoformed

component has a base sheet adjacent the face and a plurality of crush boxes extending forwardly from the base sheet into engagement with the fascia. The crush boxes each have opposing side walls and a front wall that define orthogonally-related planes, and also has top and bottom walls that are undulating in a longitudinal direction with alternating convex and concave regions. The crush boxes are open on at least one side to facilitate thermoforming the thermoformed component, the crush boxes defining shapes selected from a group of shapes where at least one of the side walls defines a concavity.

In still another aspect of the present invention, an energy absorbing system includes a beam having a face, an energy absorber abutting the face including a thermoformed component, and a cover covering the beam and the energy absorber. The thermoformed component has a base sheet adjacent the face and a plurality of crush boxes extending forwardly from the base sheet into engagement with the fascia; the crush boxes each having opposing side and front walls that define orthogonally-related planes, and also having top and bottom walls that are undulating in a longitudinal direction with alternating convex and concave regions. The crush boxes are open on at least one side to facilitate thermoforming the thermoformed component.

These and other features, objects, and advantages of the present invention will become apparent to a person of ordinary skill upon reading the following description and claims together with reference to the accompanying drawings.